

suffering. This warning of rain did much to allay the existing anxiety, and caused many stockmen to delay undertaking expensive methods to prevent loss. About one-half inch of rain occurred in the Sacramento Valley and central coast section. This was followed by another rain in northern California from the 19th to 21st.

On December 28 warnings of a severe norther were distributed throughout northern California and northwest storm signals ordered at points from San Francisco northward, and a warning of much colder weather, accompanied by snow, was distributed in Nevada and Utah. A maximum wind velocity of 32 miles an hour occurred at Eureka and 72 miles northwest at Point Reyes, and high north to northwest winds and gales prevailed throughout the State north of the Tehachapi during the night of the 28th and the 29th. Maximum velocities of wind of 36 miles per hour were reported from Carson City and Winnemucca and 60 miles at Independence. A current velocity of 20 miles from the northwest was reported from Salt Lake City. The gales in Nevada and Utah were accompanied by snow, the temperature falling to 4° and 6° above zero on the morning of the 30th in Nevada and Utah.

On the last day of the month the conditions indicated that a storm of unusual severity was approaching the Oregon coast; southeast storm signals were ordered at points along the California coast north of San Francisco. This storm verified the signals which it is believed were of considerable value.—*W. H. Hammon, Professor, Weather Bureau.*

#### FROST WARNINGS FOR TEXAS.

The morning map of December 3 showed conditions which might give injurious weather in the sugar and trucking region. A cold wave and "norther" was forecast for Texas by the Central Office at Washington, and the following warning was issued by the Galveston office of the Weather Bureau:

Probably freezing in sugar and trucking region Sunday (4th).

At 2:25 p. m. the following additional warning was distributed:

Temperature will fall to 34° and probably freezing at Galveston, and to 28° 50 to 100 miles from Galveston Sunday morning.

All sugar planters and truck growers to the coast line were advised by telegraph and long-distance telephone to protect their crops, and action was taken accordingly. The sugar cane in the north half of the sugar belt had been cut on advice given November 21. This left standing in the southern portion of the sugar belt about 40,000 tons of cane which it was desired to windrow in case of a freeze. This at the selling price in the field, \$3 a ton, made the value \$120,000. Besides this there were vegetables subject to loss by freeze which in the aggregate were worth more than \$150,000. Sunday morning the temperature fell to 35° at Galveston, 34° at Houston, and to 30° at Brenham. The reports of Sunday morning indicated a further fall in temperature and additional warnings of frost were issued, and sugar planters were advised to prepare for freezing weather. Sunday night and Monday morning there was heavy frost on Galveston Island, and killing frost and temperature as low as 28° in the sugar and trucking regions, and had not the action advised been taken cane and vegetables to the value of many thousands of dollars would have been lost. Many acknowledgments of the value of the warnings have been made. Referring to these warnings the Galveston Daily News of December 6, 1898, remarks as follows:

A heavy white frost put in its appearance yesterday morning, just as predicted by the United States Weather Bureau. While heavy white frosts occur nearly every winter on the mainland, Galveston has an average of one winter in five without frost or freezing, and even with

freezing weather heavy white frosts are uncommon on the island. Everybody looked for and made preparation for this frost, because the weather service had said it would occur. The warnings of injurious weather conditions made for this section have been so accurate of late years, and consequently of so great value to the public, that they have become a great factor with the sugar planters and truck growers who care for their extensive crops, as the Weather Bureau advises them. One feature which demonstrates their marked confidence in the warnings is that they take action to protect their crops as the warnings suggest. The different localities have systems in operation for the distribution of information. Some localities have distribution by telephone, others by mounted messenger service, and in others the planters distribute the information from one to his adjoining neighbor until all are advised.

There are few, if any, sections where the weather service can be of greater value than to this part of the country. The large sugar and truck farming interests use the warnings to such an extent that it saves them hundreds of thousands of dollars annually.

*I. M. Cline, Local Forecast Official.*

#### PORTLAND, OREG., FORECAST DISTRICT.

Signals were ordered up on the 10th, 18th, and 31st; they were verified in each instance. Numerous freighters, steamers, and sailing vessels heeded warnings and no casualties are reported.

There was no damage resulting from rain, frosts, or high winds. The river had no material rise.

The railroads made considerable use of the snow forecasts during the early part of the month. Fires were kept up in the rotary snow engines and they were moved to the mountain districts upon information issued from this office.

Two carloads of bananas were moved into Oregon and this city upon information issued, and were received and marketed in good condition.

On December 14 forecasts for snow were issued. Snowfall was general, except in and about Portland, where fair weather prevailed.—*B. S. Pague, Forecast Official.*

#### AREAS OF HIGH AND LOW PRESSURE.

During the month seven highs and nine lows were sufficiently well defined to be traced on Charts I and II. On these charts the circle is placed at the position of the high or low at 8 a. m. or 8 p. m. of each day, and inside this circle are placed the date, time, and barometer reading at the center. The accompanying table exhibits the principal facts relating to the origin, disappearance, duration, and velocity of these highs and lows, and the following special notes are added.

The month has been characterized by pressures largely above normal in the southwest and west, and these conditions have controlled the development and motion of the highs and lows. Oftentimes the rather permanent high area in the Plateau region has spread southeastward into Texas but without any motion.

*Highs.*—High No. II was the only one originating on the Pacific coast; III and IV were first seen in the north Plateau region, VII to the north of Montana, I in Kansas, and V and VI to the north of Lake Superior. The general motion was to the eastward or southeastward. Nos. II, III, IV, and VII were merged in a subpermanent high in the Gulf of Mexico or over Florida, and I, V, and VI were last noted in the Gulf of St. Lawrence. The temperature oscillations accompanying these highs were very moderate up to the last week of the month. On the morning of the 27th, as No. VII approached Minnesota, Winnipeg experienced a fall of 50° in twenty-four hours and to -18°, and Moorhead a fall of 38° and to 4°. On the evening of the 28th, as the same high approached the Atlantic coast, Northfield reported a fall of 41° and to 8°, and the next morning Eastport reported a fall of